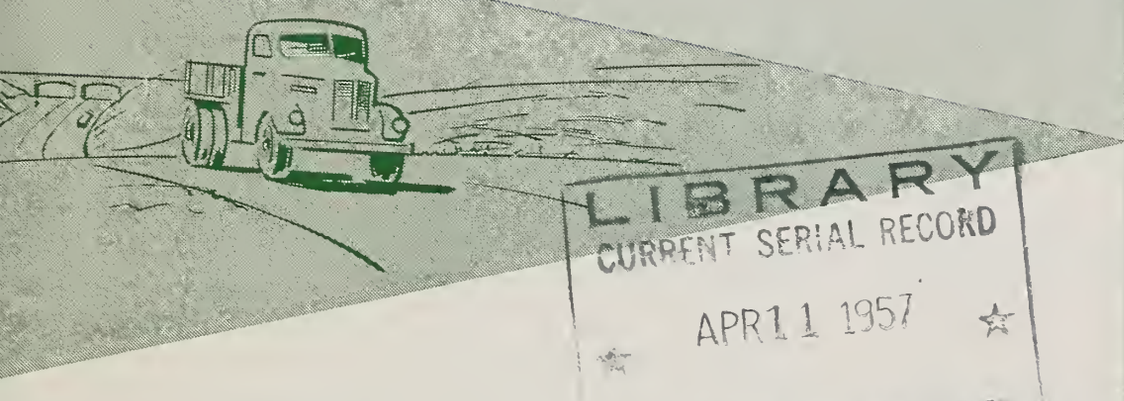
APRIL 1957

# AGRICULTURAL Research

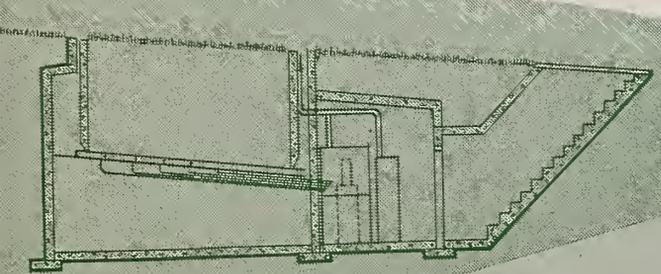














UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL
# Research

Vol. 5—April 1957—No. 10

## CONTENTS



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## Basic

Entomologists are concerned about the threat of today's counterattack by insecticide-resistant insects.

We may be able to hold the line now, but there's little chance of pushing forward if we stick to the old tactics.

With cotton, for example, we have been busy evaluating new insecticides and developing them for field use. And for good reason: chemicals provided the only generally dependable and practical control. Each year brought new successes.

Then we ran up against this matter of resistance.

Basic information is needed. Unfortunately, we've let our reserve run low—the pressure of the last decade left little time for fundamental work. We need to rebuild this reserve.

We must still devote a lot of effort to *chemical control*, of course. But we must broaden our approach. We need more chemical-related research along five lines: (1) insect physiology and toxicology—what controls insects' processes; (2) mechanism and cause of resistance—to guide us in finding insecticides that give indefinite control; (3) systemics—overcoming objections and limitations of conventional insecticides (weathering, damage to beneficial insects, health concerns); (4) attractants—virtually unexplored, leading to ways to lure and destroy insects; (5) insect growth regulators—mechanisms, and materials that upset these mechanisms.

There are also possibilities in *cultural and biological control.* Insects' hazards include food shortage, enemies (parasites, predators, diseases), and adverse weather. Let's see what we can do to help nature control insects. In south Texas, regulating planting time and destroying plants after harvest keeps down pink bollworm and boll weevil losses.

Development of suitable *insect-resistant plant varieties* takes time (10 years or more) but is otherwise a nearly ideal answer to insects. Cooperating plant breeders and entomologists are achieving good results on wheat and corn.

In all these fields, we need to build up more fundamental information on which to base progress on applied research in the years ahead. We dare not wait and depend on crash programs—mere stopgaps. We need to step up our efforts now.

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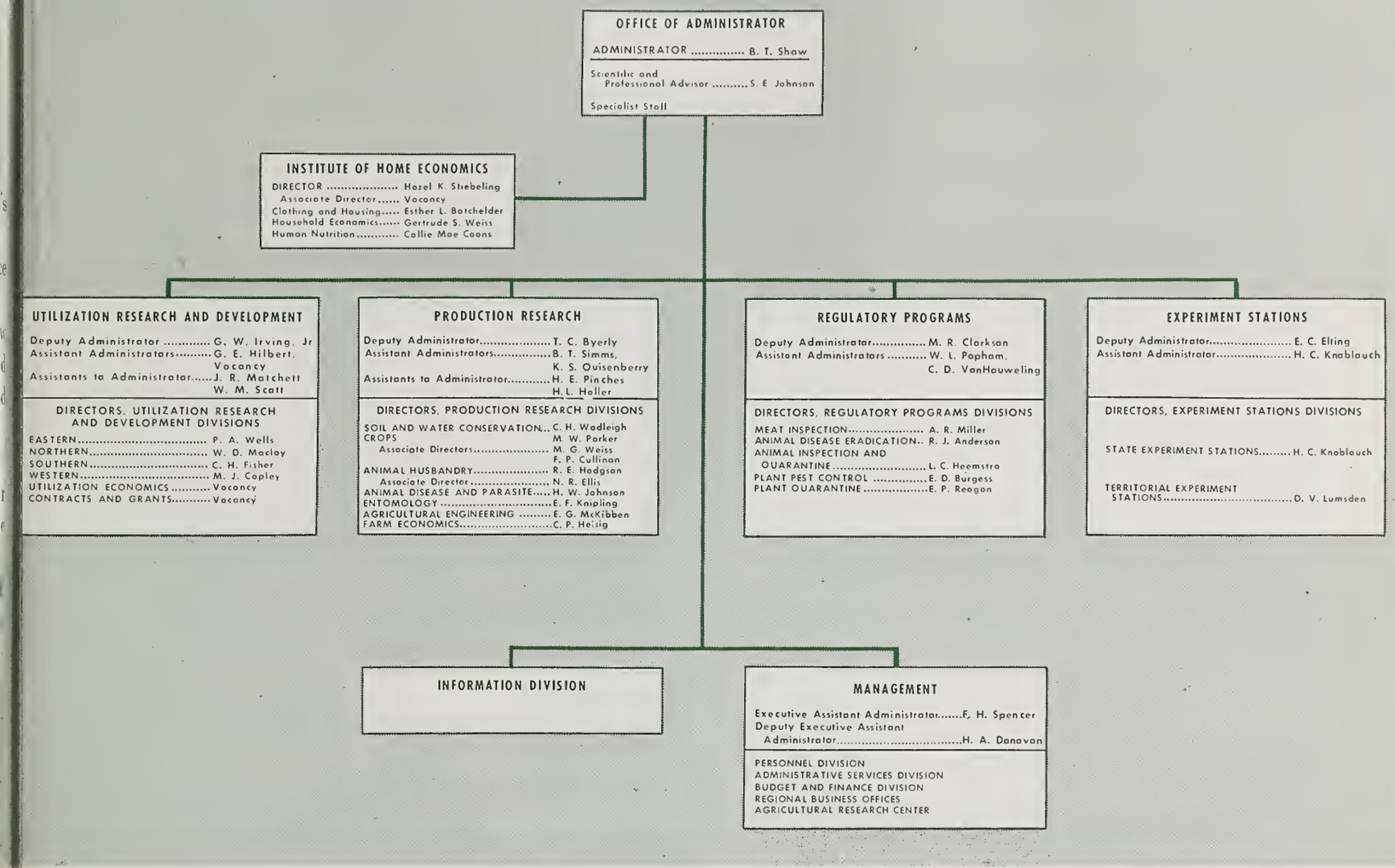


# New Emphasis on UTILIZATION

## That's the main objective in regrouping ARS research functions

■ RESEARCH AND DEVELOPMENT work on the utilization of farm products is given added emphasis in a recent regrouping of functions within USDA's Agricultural Research Service.

Under the new alignment, utilization studies are administered separately by a Deputy Administrator for Utilization Research and Development. Production research is also regrouped, under a Deputy Administrator for Production Research.

This regrouping of administrative responsibilities reflects our increased emphasis on utilization research, in line with current economic trends and recommendations of farm organizations and advisory groups.

Named by ARS Administrator B. T. Shaw to the new post of Deputy Administrator for Utilization Research and Development is G. W. Irving, Jr., previously Deputy Administrator for Research. Deputy Administrator for Production Research is T. C. Byerly, who was Assistant Director of Livestock Research.

Studies in human nutrition, household economics, and clothing and housing are grouped in a new Institute of Home Economics. Director Hazel K. Stiebeling, formerly Director of Home Economics Research under the Deputy Administrator for Research, now reports directly to the Administrator of ARS.

Reporting to the Deputy Administrator for Utilization Research and Development are the Directors of 6 Divisions, replacing the 4 Branches formerly concerned with this work.

Reporting to the Deputy Administrator for Production Research are the Directors of seven Divisions.

Unchanged are the responsibilities of the Deputy Administrator for Regulatory Programs, M. R. Clarkson; the Deputy Administrator for Experiment Stations, E. C. Elting; and the Executive Assistant Administrator for Management, F. H. Spencer.

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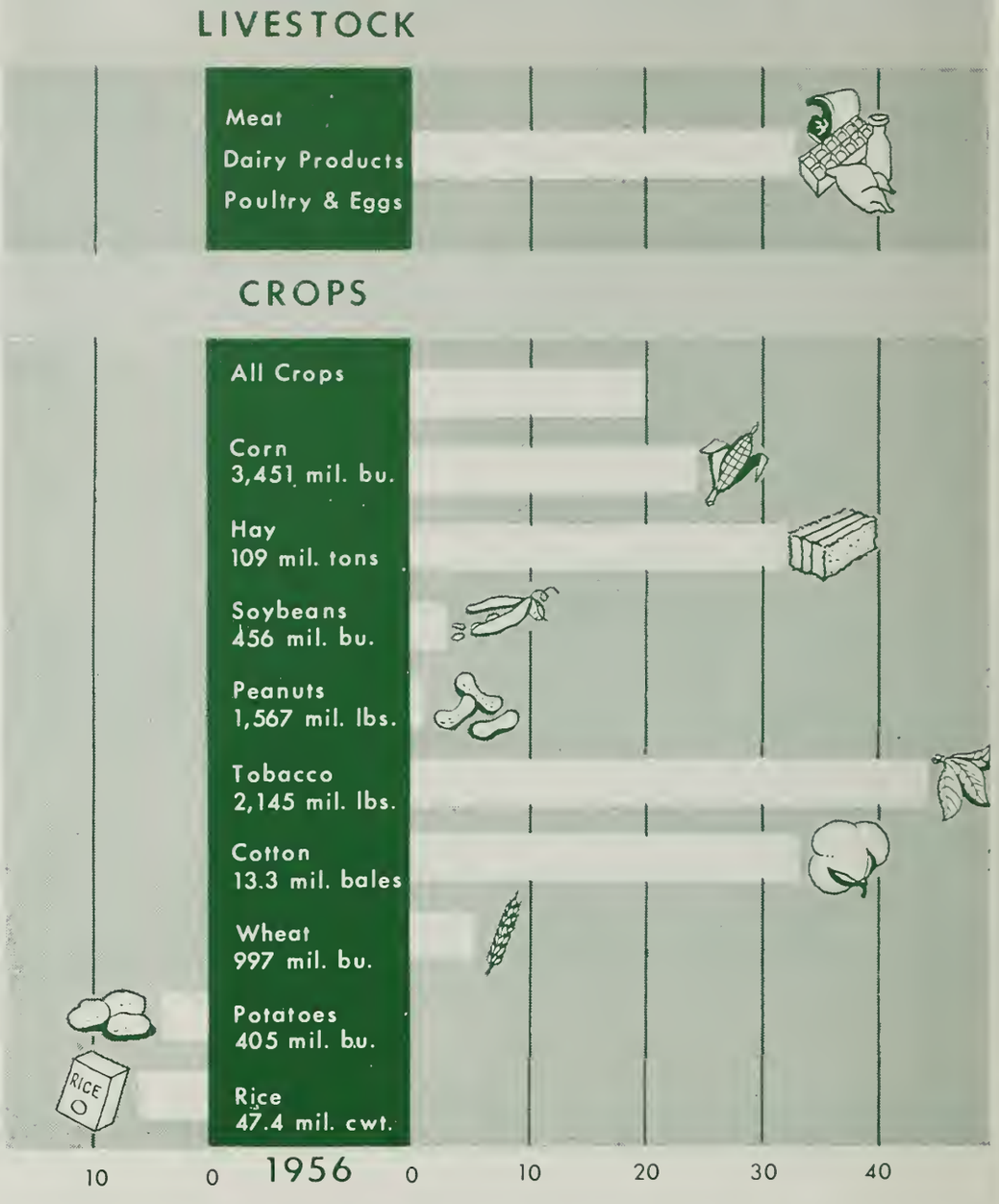
# OUR NEEDS IN 1975

**We may have to produce one-fourth more, mainly by way of bigger yields and increased efficiency**




FARMERS PRODUCED almost 40 percent more last year than in 1940—yet they still have a big production job ahead. USDA projections for 1975 indicate need for a 25-percent increase in total output over 1956.

Livestock production needs alone could be a third above last year, according to a study by ARS economists G. T. Barton and R. O. Rogers. Projected needs for crop production may be 20 percent above 1956.

Assuming that the pre-acre yields of 1951–53 (base period for the study) still held in 1975, the equivalent of more than 150 million additional acres of cropland (above the 1951–53 level) would be needed. But if trends of the past 15 years continue, we may be able to add only about 25 million acres to our cropland base. This would come from the transfer of grassland pasture to cropland rotation and from development of nonproductive land by irrigation, drainage, and flood control.

Five-sixths of the increase in production needed, measuring from 1951–53 to 1975, would have to be obtained from greater yields and increased efficiency. By 1956, yields had increased significantly over 1951–1953, through improved practices.

Subtantial increases in our needs for feed grains, hay, and pasture reflect increases in the needs projected for livestock. Food grain needs are expected to be substantially below quantities produced in 1951–53 before allotment programs went into effect, but above 1956 levels.

Total livestock production (meat, dairy products, poultry and eggs) was at an alltime high in 1956. This included, however, a drop in meat animals of less than 1 percent from 1955, mainly because of a reduction in hogs. Production of meat animals in 1975 may need to be 35 percent greater than the 1956 outturn.

Production of poultry and eggs, which was higher in 1956 than 1955, may need to expand by 35 percent to meet 1975 needs. Milk (127 billion pounds for 1956—3 percent more than in 1955) would have to be 20 percent higher in 1975.☆

# ZINC prevents and cures PARAKERATOSIS

## Growth-retarding disorder is brought on by zinc-calcium imbalance

■ ZINC HAS BEEN successfully used by USDA scientists to threat parakeratosis—a serious, non-infectious, mange-like affliction of swine. Although this disease seldom kills animals, it seriously retards their growth and causes skin lesions, occasional diarrhea, and poor appetite.

Zinc's effectiveness in treating parakeratosis was confirmed by ARS animal husbandman J. W. Stevenson and biochemist Imogene P. Earle of the Agricultural Research Center, Beltsville, Md. These researchers fed 8 lots of 6 pigs each on diets varying in zinc and in calcium. Calcium is thought to intensify incidence and symptoms of parakeratosis by causing a mineral imbalance in the diet.

A diet containing 32 parts per million of zinc and 0.48 percent calcium produced mild to moderate parakeratosis in 3 of 6 pigs. Increasing calcium to 0.67 percent or to 1.03 percent at the same zinc level (32 p. p. m.) produced severe parakeratosis in all pigs of 2 other lots.

### Adding zinc prevents disease

Addition of zinc oxide to increase the total zinc content of the pigs' diet to 44 p. p. m. reduced the severity and incidence of the disease. Further addition of zinc oxide to increase the zinc level to 80 p. p. m. completely prevented parakeratosis in other animals, even with the calcium level maintained at 0.67 or 1.03 percent.

### Therapeutic effect is shown

Diets of the pigs were reversed after 42 days to determine the curative powers of zinc and possible carryover of its protective effects. Animals previously getting small amounts of zinc were now given additional quantities; animals previously getting large amounts were given less. Calcium level remained constant.

This diet change demonstrated the rapid therapeutic effectiveness of zinc. Improved appetite, dramatic weight gains, dried skin lesions, and decreased diarrhea were noted within the first week in animals fed more zinc. This was followed by a gradual loosening and shedding of the scurf and scabs that accumulated during the active stages of parakeratosis.

The shift from high to low zinc in the diets gave somewhat slower and less dramatic effects in reverse. First definite lesions appeared 21 days after the diet change. In 28 days, parakeratosis had become established in 1 of 3 pigs on the 0.67-percent calcium level and 2 of 3 pigs on the 1.03-percent calcium level.

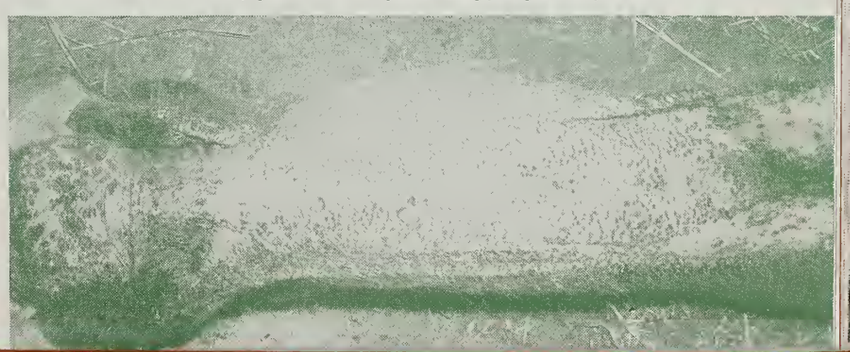
Results indicate that in diets containing up to 1.0 percent calcium, minimum zinc content for prevention of parakeratosis in growing pigs is between 44 and 80 p. p. m. Zinc can be obtained commercially in the form of trace-mineral supplements; farmers must be careful, however, to see that supplements contain a high enough percentage of this vital mineral. Parakeratosis has been inadvertently caused in the past by feeding mineral mixtures with too much high-calcium bone meal or calcium carbonate and little or no zinc. The importance of trace-mineral supplements in pigs' diets is recognized, but much work remains to be done to determine exact requirements.

### Blood chemistry under study

Studies on blood chemistry, though not conclusive, provide preliminary data for work on probable mechanisms involved in producing parakeratosis. Results suggest that it may depress levels of hemoglobin, serum inorganic phosphorus, and blood sugar. In addition, parakeratosis may cause a shift in albumin-globulin ratio. Pigs given 32 or 44 p. p. m. of zinc had extremely variable serum alkaline phosphatase activity compared with pigs eating 80 p. p. m.☆

**WEIGHT GAINS** in pigs fed extra zinc were immediate and marked. Zinc-deficient pigs, like one at left, average —0.11 to .25 pound daily on diets with only 32 parts per million zinc and 1.03 percent calcium; 0.25 to 0.96 pound on 0.67 percent calcium. Pigs fed 80 p. p. m. zinc, like pig at right, average 0.79 to 1.30 pounds with 1.03 percent calcium; 1.37 to 1.81 pounds with 0.67 percent calcium.

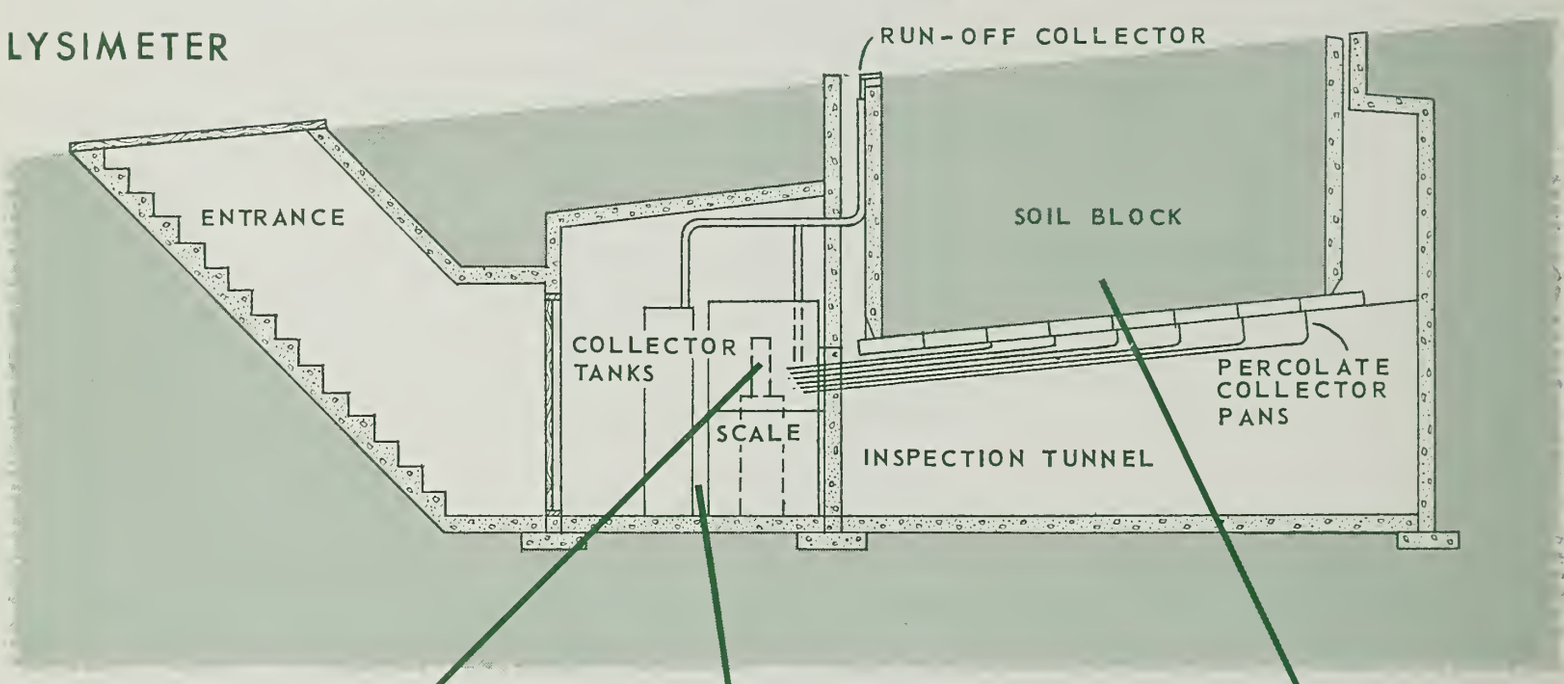
**FIRST SYMPTOMS** of parakeratosis are red, pimple-like areas that appear on abdomen, front, and rear flank of pig. Lesions soon develop on skin of flank, pastern, fetlock, hock, and around the nose, ears, and tail. Crusts of lesions are separated by crevices that contain exudate. Skin dehydrates and forms large wrinkles. Secondary skin infections are common; pus sacs may develop, especially in ham area.

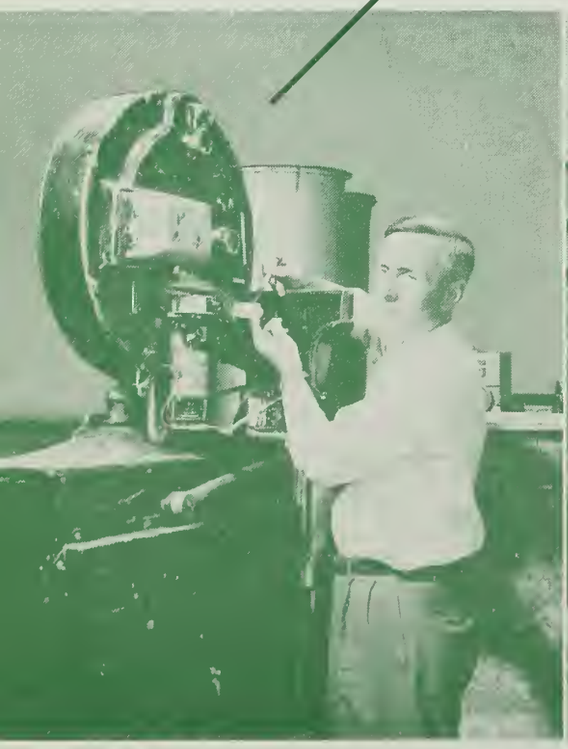


# WHAT HAPPENS TO

**Work at Coshocton measures precipitation and shows where it goes, what it does to soils, how crops use it**

LYSIMETER



WEIGHT OF SOIL resting on the scale is stamped every 10 minutes onto a revolving paper tape. L. L. Harrold, supervisor at Coshocton, points out variations in weight.

PERCOLATION WATER is drained from the bottom of the earth block and collected in tanks. Samples of this water are taken periodically and tested for mineral content.

SAME CROP ROTATION and soil management practices are used on this 1/500-acre plot as on the surrounding field. Lysimeter data reflect the status of the entire field.

# WATER

■ IN THE COSHOCTON hills of eastern Ohio a 65-ton monolith of earth rests on a giant scale. On this 1/500-acre block or lysimeter, as in the surrounding field, crops are grown in a 4-year rotation typical of the area.

Year in and year out, the weight of this earth block is automatically recorded every 10 minutes. Variation as little as .01 inch of water is shown. The scale is tipped to the plus side by the evening dew, to the minus side by evaporation from ground and foliage. by transpiration (release of water from the plant leaf pores), and by percolation through the soil. Tests of the water drained off tell how much of various nutrient chemicals leach through the root layer.

The lysimeter and other devices used in USDA studies in Coshocton have given much information on soil and water relationships in the North Central and Northeastern States.

ARS hydraulic engineer L. L. Harrold, supervisor of the Watershed Hydrology Station at Coshocton, attaches great importance to moisture condensed from the air—about 2½ tons per acre on an average summer evening and over 6 inches in a year. In August 1951, dew supplied three times as much moisture as rainfall and was effective in reducing wilt.

### Many factors affect rain use

The usefulness of rainfall depends on many factors. These include porosity of the soil, kind of ground cover and its stage of growth, treatment of the slope, and intensity and duration of the storm. More than 80 percent of our annual erosion comes from summer rains of great intensity.

A brief *pounding* rain of 1.1 inches fell at Coshocton July 28. The top 7 inches of soil had 2.8 inches of unsaturated pore capacity, but only 0.6 inch of rain soaked in. In a *slow* 4-inch storm September 1, the same soil with the same unfilled capacity took 3 times as much water. Runoff was 5 times as great but soil erosion a fourth less than in July.

Mulches ease the pounding of rain—would have saved the July rainfall in its entirety, the September rain to the extent of pore capacity.

### Contours slow water runoff

Harrold and his associates found that contour farming slows down the runoff from a rain so the soil can take more in. On a Coshocton slope over a 12-year period, a cornfield on the contour consistently had less runoff and only a fourth as much erosion as the adjacent field with straight rows and traditional tillage.

Applying a manure mulch to corn following the first cultivation raised water storage in the soil in one test. Late in August, the top 7 inches of soil in a mulched field was 22 percent water by weight. That's well above the water content at which plants wilt. By contrast, an adjoining unmulched field had only 8 percent moisture—about wilting point.

The Coshocton records also tell what becomes of water that reaches the soil. Of Ohio's average 38 inches of rainfall, 13 inches ordinarily go by surface runoff or by soil percolation into the streamflow. Twenty-five inches go into the air by evapo-transpiration from soil and plants. But in 1953, when only 29 inches of rain fell, only 4 inches of water remained for the streams after evapo-transpiration had taken its full toll.

Obviously, disposal of moisture depends on the soil and crop situation, as Coshocton's records show for 41 inches of rainfall in 1941. On grassland, 1 inch of water ran off the surface and 12 inches percolated below the root zone into the ground-water reservoir. Crops consumed 28 inches of water. On corn land, 15 inches of water ran off the surface and 3 inches percolated through the root zone. That left 23 inches for the crop, but that was 5 inches less than the 28-inch water requirement for an 80-bushel corn yield. The crop had to draw on reserve water.

Soil treatment is a well-known factor in runoff. On a Coshocton slope, runoff in 1948 was 2.86 inches on land in straight rows, 1.14 inches on land in contour rows, only .05 inch on land contoured and mulched.

### Source of moisture explored

Records from the lysimeter and other moisture instruments have given significant information on the source within the soil of the water used by plants. For example, in early August of one year, corn took 75 percent of its moisture from the top 7-inch layer of soil and 15 percent from the next 7-inch layer—a total of 90 percent to a depth of 14 inches. But late in August, the corn took only 72 percent within the 14-inch depth—about half of it from each of the 2 layers. It's important to know water-extraction patterns so irrigation water can be supplied to the proper depth without wasting it. ☆

Here's What Can Happen

EXPOSED BANKS like this erode for years and demand frequent and costly maintenance. Winter freezes and thaws loosen the dirt and cause it to wash or slide into the drainage ditch or onto the road. Erosion doesn't end until bank is properly formed, seeded, and maintained under a good vegetative cover.

TIGHT PLASTIC CLAY subsoil in this roadcut is slumping into the gutter, due to failure of the cover crop. It usually takes more than seed and fertilizer to make this kind of soil hospitable to a cover crop. Better soil preparation at the start may prove cheaper than ditch maintenance.

ONCE COVERED with vegetation, this bank is now losing its ground cover and eroding because the crop was not kept in vigorous growing condition with fertilizer. Six-man crew with truck is required periodically to clean gutters. Timely fertilization, costing little, would have saved this expense.

EXPENSIVE REPAIR, not to mention the hazard to motorists, was a consequence of having no ground cover to hold the ditch and shoulder. This repair took several days work with a power shovel, a bulldozer, six trucks moving dirt, and several workmen.

## AGRICULTURAL RESEARCH FOR

# Better Highways

**Roadside cover—a new kind of agriculture—can mean much to success of system being planned**

RIBBONS OF CONCRETE and asphalt will soon stretch over plains, foothills, valleys, and mountains to form a new highway system, adequate and safe for fast-growing America.

This is a program in which Americans will invest some $33 billion in about 15 years—President Eisenhower's plan for 41,000 miles of interstate and defense roadways linking com North, East, South, and West.

Agricultural research has a part in that task—to determine the best vegetative cover for the rights-of-way. This means studies on soils and plants to provide erosion control, safety, permanence, low-cost maintenance, and beauty for these highways destined to be traveled by millions.

USDA is cooperating with highway planners and engineers in many States. ARS researchers are studying the roadside soil, water, and plant adaptation problems. These constitute, in effect, a new kind of agriculture, with intensified problems in water diversion and runoff control.

### Age-old subsoils uncovered

Rights-of-way will be cut to make these new paved roadways as level as possible. That means millions of tons of earth must be moved in making cuts and fills. This will uncover subsoils formed countless ages ago—normally unsuitable for cropping because they lack the structure and nutrients that make plants grow.

Yet, these exposed surfaces must be made to produce vegetative cover to prevent erosion. Road shoulders must be kept firm and smooth to provide safe emergency turnouts for motorists. Fills must not wash out to form dangerous gullies and ditches. Erosion of cuts must be checked to keep eroding materials from damaging farm lands, or washing onto highways to endanger fast-moving cars. Vegetative cover is also needed to reduce repair and maintenance costs on the roads.

In solving these problems, agronomists, soil scientists, and agricultural engineers rely on fundamental knowledge in their respective fields. But even more, they draw on past successes and failures in right-of-way maintenance practices, and practical application of their own efforts along highways that are already in use.

### Soil prepared and fertilized

Soil preparation is the first step once a right-of-way has been graded. Then plant nutrients must be applied to freshly exposed subsoils.

Such soils, used in fills, are already well tilled and usually need little more than lime and fertilizer. Cuts often require surface working with tillage machines before they are fertilized and seeded. Careful mulching, as developed for erosion control on farms, has become standard practice to provide the microclimate favorable to

But This Can Save Roads

STRAW, TREATED with a spray of asphalt emulsion as it is blown from the spreader, will form a protective mulch for this newly seeded roadside bed until the seeds sprout and get well established. Asphalt is applied as straw leaves the tube. The bed was previously fertilized and seeded with the same machine.

SEED-BEARING SERICEA lespedeza hay broadcast on the raw roadside cut served three purposes. The mulch prevented washing during the winter. Seedlings took root in the spring and formed a tenacious ground cover. Decayed hay made welcome organic matter. Hay was applied at rate of 4 tons per acre.

SOD IS ALL RIGHT in its place, though expensive. But it is difficult to anchor sod on steep slopes. Bluegrass needs ample moisture to survive. This sod has slipped in places and is dying in patches on the dry, gravelly soil. This site calls for a deep-rooted species adapted to growing in subsoil.

DEEP-ROOTED KUDZU, if started and maintained right, holds the steepest banks. Planting was in rows with a slit of fertilizer about 6 inches away. The importance of choosing an adapted species and maintaining it properly can not be overemphasized.

germination and prevent seeds and soil from washing before roots form.

Use of imported topsoil to establish roadside cover has limited practical application. This is justified only in extraordinary situations. Sodding is even more expensive.

Site conditions govern choice of vegetation. Tough grasses and legumes that can be mowed short are best for road shoulders. Once established, they withstand the 100-percent water runoff from pavements with little danger of ditching or gullying. Vigorous-growing grass and leguminous covers have proved wise for slopes and banks. Once started, these plants are at least partly self-supporting—important since fertilization and mowing of long, steep slopes are difficult. Legume root systems help prevent erosion (and plants often provide feed and cover for birds).

Planting of trees on highway banks should be done with caution. Such plantings do not always provide the ground cover necessary to prevent erosion. In fact, by shading grasses and robbing soil of nutrients and water, trees may tend to discourage grasses that might otherwise grow.

### Many suitable covers found

Several varieties of legumes and grasses have been found suitable for highway ground cover, and the search has only begun. At the Agricultural Research Center, Beltsville, Md., and on State highways in the East and South. sericea lespedeza, and kudzu in limited use, have proved well adapted for hillsides too steep to mow. Annual lespedcza is also useful to give quick cover while more permanent plants are getting established.

Tall fescue grass shows marked promise over a wide area as a stable, lasting ground cover. Other grasscs such as zoysia, Bermuda, and common redtop have been used successfully. Covers of other types, including vines and shrubs, are under study.☆

# ONE Respirator for ALL Pesticides

■ When USDA SCIENTISTS started experimenting with chemical control of insects in greenhouses, they had to design devices to protect themselves from toxic effects. First they used masks and separate cannisters to guard against insecticide injury. Then they designed a combination respirator and mask. Recently they found that the same respirator-mask keeps out fungicides and nematocides as well as insecticides.

The respirator consists of two units on a small facepiece fitted to the nose. Each unit contains an activated-charcoal cartridge covered with glass, wool, or wood-fiber filters. (Glass fibers are less than one micron in diameter, and the finished filter is almost weightless.) The combination of filter and activated charcoal cartridge keeps out toxic sprays and dusts as well as odors—yet permits normal breathing.

The new type filters that stop all insecticides were developed 2 years ago. Then the equipment was tested against fungicides and nematocides and approved for all three uses in the last few months. The unit has been approved by the Civil Aeronautics Authority for pilots. Legislation has been passed in some States and is underway in others to require use of the equipment. It sells for less than $5.

Adequate protection for pilots during normal dusting and spraying is provided with this respirator, say ARS chemist R. A. Fulton and pathologist W. D. McLellan. But extra precautions should be taken during formulating, grinding, loading, and disposing of empty containers. The original full-face gas masks with a tight seal around the entire face should be worn with an approved cannister. This is also true with volatile pesticides in greenhouses or enclosed spaces.

During operations with either type of equipment. proper protective clothing should be worn. Hands should be washed before eating, a shower taken at the end of the working day, and clothes changed daily.

The respirator, evolved at the Agricultural Research Center, Beltsville, Md., has been tested by scientists at State agricultural experiment stations. Units were tried on field men and pilots with faces of various shapes. Now manufacturers supply special facepieces if standard equipment does not provide a good seal. When headbands are adjusted tightly, the narrow portion of the facepiece is over the bridge of the nose and the chin cup contacts the underside of the chin.

Researchers suggest changing the filter twice a day, or oftener if breathing becomes difficult. The two faceplate cartridges are changed after 8 hours of actual use, or oftener if odors are detected. After each use, filter and cartridges are removed; the facepiece is washed with warm water and soap. rinsed thoroughly. dried with a clean cloth, and put in a tightly closed paper or plastic bag in a clean, dry place. ☆

# CAN INSECTS FIGHT HALOGETON?

## We may find an ally against this deadly weed among insects collected in exploration of Europe, Asia

■ Findings of a USDA traveling entomologist may lead the way to solving the problem of halogeton, weed that kills cattle and sheep.

G. B. Vogt, of ARS, found 80 to 120 different insects feeding on halogeton and related plants when he visited native habitats of the weed—arid sections of Europe and Asia.

Scientists hope to find a way to control the halogeton that grows in the United States. This particular type—*Halogeton glomeratus*, native of Russia—was first found in Nevada several miles southeast of Wells, Elko County, at 5,500 feet in 1934. But it was not until 1942 that the dangerous effects of the plant were realized.

Some 9 million acres of rangeland are infested in Utah, Nevada, Wyoming, Idaho, Montana, California, Colorado, and Oregon, with up to 360 seedlings per square foot. In 1950, only 2 million acres were infested.

Small quantities of halogeton (blue green in spring and tan in fall) are fatal unless eaten with other feed. A half pound (dry weight) of the weed will kill a mature ewe within 6 to 12 hours. Sheep become drowsy and listless, weak and unsteady—similar to symptoms of "milk fever."

### Oxalic-acid salts are deadly

Halogeton contains large quantities of soluble salts of oxalic acid, poisonous substances that combine with the calcium in the blood stream. Death results from rapid lowering of the blood calcium concentration. Kidney sections examined under polarized light often reveal large aggregates of insoluble calcium oxalate crystals lodged in tubules of the cortex. The oxalic content of halogeton is higher in fall and winter.

### Control of weed is difficult

Chemical controls have proved too expensive. And reseeding, forage developments, and good range management only minimize destructive effects. Animals are less apt to eat halogeton when there is other forage.

Since the Klamath weed has been controlled to a great extent in some western States by biological means, weed researchers and entomologists feel there's a possibility of achieving the same goal with halogeton.

Entomologists C. J. Davis and J. J. Drea, who worked with Vogt, are propagating and testing the insects with the cooperation of the Iranian Minister of Plant Protection and the U. S. Operations Mission to Iran.

Insects and plants will be studied to determine the period of growth when the insect is most destructive and the plant most susceptible. But since halogeton is closely related to sugar-beets and spinach, insects will also be tested against these and about 100 other U. S. economic plants.

Seed of range grasses, vegetables, and halogeton have already been sent to the Tehran laboratory to be grown and tested. Insects that feed only on halogeton will be imported and processed at Albany, Calif., for use at the most effective period in the life cycle of the plant and the insect.

Entomologist Vogt, who has background in botany and geology, located *Halogeton sativus* growing on disturbed soils around fallow fields, spoil dumps of excavations, and along roadsides at low elevations in Spain. He found two small colonies of *Halogeton alopecuroides* in the Syrian desert between Damascus and Palmyra in locations up to 2,000 feet elevation. Vogt explored the Gurgan-Gunbad section east of the Caspian Sea in Iran without finding halogeton, but he brought back an unrecognized species from Shahrud and Ghom to the south in the country's more arid regions.

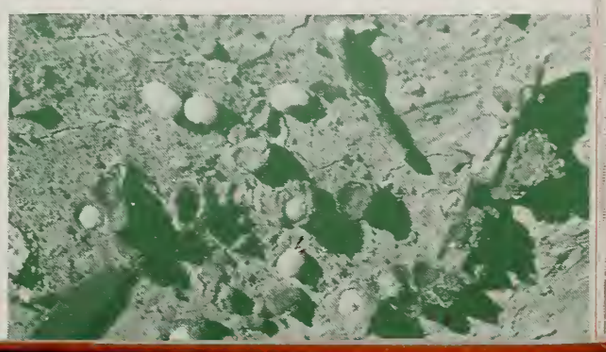
### Our species found only once

*Halogeton glomeratus* (the species in the U. S.) was found only among cliffs at elevations of 7,000 to 8,500 feet in Bamian, Afghanistan.

A fifth species of *Halogeton* was found in Ladakh growing in cobble and gravel as well as in granite sand overlaying sedimentary soils 10,500 to 14,000 feet above sea level.

Twelve to 18 insect species were found on *Halogeton* and related plants in each country—several insects in two or more countries.☆

WHITE WEEVIL grubs are found on unidentified species of *Halogeton* on flat ranges of Iran. ARS entomologists (pictured above) searched Europe and Asia to collect insects.



# HOW SUN MAKES APPLES RED

SOME FARMERS GROW red apples by selecting specific varieties. Other farmers live in areas where the skins seem to grow brighter. Still other growers expose apples to sunlight for several days after harvest.

The last method—sometimes considered an old wives' tale—turned USDA's scientists into detectives to seek the truth of the matter. H. W. Siegleman, Agricultural Marketing Service horticulturist, and S. B. Hendricks, ARS chemist, started experimenting with the relationship of light to color of apples a year ago.

They found the practice of spreading apples on the ground in orchards for a few days is backed by more than imagination—if fruits are of a variety that's capable of turning red.

### Two relationships revealed

They proved that light does have an effect on the development of red color in apples. And they found out why. In addition, these researchers made another discovery that possibly relates color to breathing.

First, they analyzed the red pigment. This contains anthocyanins, which are responsible for color in red cabbage and turnip seedlings as well as apples. By conducting round-the-clock experiments (first with seedlings, then apples) under different colors of the spectrum, the scientists watched anthocyanins develop.

Tests were made with early-harvested fruits with green skins—Jonathan, Rome Beauty, and Arkansas varieties—held in storage at 32° F.

Different apples were placed under fluorescent light for about 40 hours, then under 12 hours of light from various regions of the spectrum ranging from red to blue-violet. This determined the effect of different wave lengths of light on anthocyanin formation. Then the apples were placed in a dark room for 24 hours to allow the red color to develop without interference of other rays of light.

The researchers learned that each variety of apple turned red fastest when exposed to the red light of the spectrum. Then, after doing more detective work, they discovered that the pigment absorbing the light appeared to be related to Vitamin $B_2$—associated with copper. The combination forms copper flavo-protein. This is probably similar to a green enzyme that appears in animal liver and takes part in the control of the animal's metabolism of fats.

### Color and breathing coupled

Scientists believe that this copper flavo-protein within the pigment of the red apples is likely to be coupled with the enzymes that burn sugar with oxygen in respiration. The experiment points the way to new questions now under study on the relationship of color and respiration.

So science now has a new basis for searching for ways to improve the quality of apples after harvest.☆

# N AND CANNED-PEACH QUALITY

EXPERIENCED PROCESSORS put all their skill and know-how into the preparation of tasty canned peaches.

But skill and know-how may not always be enough to produce top-quality canned peaches if adequate nitrogen fertilization was not first utilized to produce vigorous peach trees.

Studies at USDA's Fruit and Vegetable Products Laboratory, Prosser, Wash., and Washington Agricultural Experiment Station, Pullman and Prosser, showed that such fertilization greatly improved quality of canned fruit. This work also showed the effectiveness of using leaf nitrogen as a criterion of nitrogen status in the tree. Leaf analysis is frequently used to determine nutritional needs of plants and trees and to help produce fruit that is suited for a specific market (AGR. RES., August 1955, p. 5).

### Study shows high correlation

Chosen for sampling were Elberta peach trees with leaf nitrogen from a low of 1.59 percent to a high of 3.20 percent. The trees had received varying levels of nitrogen—from none at all to 2 pounds a tree annually. Trees were grown on orchardgrass, rye, or vetch. Samples of fruit were harvested, processed, and evaluated chemically and by taste panels.

High correlations were found between leaf nitrogen and canned fruit quality. High-nitrogen canned peaches were firm and had good color and texture. Low-nitrogen canned

peaches were astringent, fibrous, soft, and frequently unpalatable. Flesh of the low-nitrogen fruit tended to adhere to the pit. More striking was the loss of firmness and shape of halves when steamed before peeling. This was in sharp contrast with high-nitrogen peaches, which retained their shape very well under steam.

Low-nitrogen fresh peaches—unlike the canned product—were firm, handled well, and had a bright golden color and attractive blush. Lowest-nitrogen fruit tended to elongate.

### Color, appearance influenced

As leaf nitrogen was increased, canned-fruit flesh color became deeper and appearance (shape, looks) improved. Quality improvement leveled off with higher nitrogen.

Various chemical constituents of the fruit were related to nitrogen. Tannin, for example, was lowest in high-nitrogen peaches, soluble solids and acidity lower and ascorbic acid higher in high-nitrogen fruit.

Researchers say peach canning quality can be improved by nitrogen fertilization of trees, but disadvantages may include greater preharvest drop and greater variation in fruit maturity. This means that although 1 or 2 pickings for commercial processing are enough for low nitrogen trees, 4 or 5 pickings may be desirable with high-nitrogen trees.

Because high-nitrogen Elbertas are riper than their basic color indicates, they must be picked with much more green color than low-nitrogen fruit to avoid excessive bruising.

Scientists observed that nitrogen nutrition involves more than too much or too little. It's a continuous function with steady, stable distribution from low to high. Nitrogen leaf analysis should be used as a continuous check on plant nutrition.

### Analysis, feeding desirable

Leaf analysis and nitrogen fertilization may be used as tools to improve the canning quality of fruit from trees that look fairly vigorous, and certainly from trees showing nitrogen-deficiency symptoms. Canners who are looking for a quality product should be cautious about buying peaches from low-vigor trees.

Effects of excessive nitrogen application on canned-fruit quality will be investigated in later research. ☆

# MEDFLIES—ON THE WAY OUT

■ One year ago this month the Mediterranean fruit fly was discovered in Florida. But thanks to new research developments and a $10 million effort by USDA and the State, eradication is expected before the peak of another citrus shipping season.

The job could not have been handled with methods used in the 1929 outbreak, say ARS entomologists. Eradication of the insect, which threatened to cut the value of Florida's $400 million fruit and vegetable crop, is being achieved because of:

### New methods play big part

1. Successful combination of protein-yeast attractant with malathion to form a poisonous bait spray that draws the flies to the insecticide. This may be sprayed over large areas and does not have to settle directly on the insects. The mixture, in amounts used, is harmless to humans.

2. Good timing of the discovery of the attractant qualities of angelica-seed oil—substance made from a carrot-like plant grown in Belgium. Entomologist L. F. Steiner and associates at the Fruit Fly Research Laboratory in Honolulu developed the lure in time to use for the Florida outbreak. Field workers use the materials in traps, and sprays are applied where flies have been located by such trapping or when larvae infiltrations are located by cutting fruit.

3. Chemist S. I. Gertler's quick development of a synthetic attractant—ENT–21–478, one of a series of compounds of esters—at the Agricultural Research Center, Beltsville, Md. This discovery proved invaluable in view of dwindling supplies of angelica-seed oil. (The United States normally uses about 3 pounds a year for liquors and perfumes. World production totals only 600 pounds annually. Medfly field workers used 1 year's supply plus a small reserve.) Synthetic compounds were sent by plane to Hawaii for testing, and island workers telephoned, telegraphed, and airmailed results to Beltsville.

Now a systematic followup by Beltsville chemists working with entomologists in Hawaii (where insects are available) has brought forth an ester that attracts even more Medflies.

4. A plastic trap newly designed by Steiner. It's more efficient and less expensive than the bell-shaped glass container that was used previously.

### Trapping, spraying continued

Today, some 50,000 traps are still scattered throughout 25 Florida counties. Commercial companies continue making the synthetic attractants—those developed by government chemists and entomologists—to detect any remaining infested areas.

Bait sprays will continue to be applied to all areas where flies are trapped. Traps will be maintained with the new synthetic attractant and limited amounts of angelica-seed oil for an extended period after the last Medfly of the present infestation is eradicated. Collections (as of press date) are becoming smaller. ☆

# LOCKER PLANTS GROW IN ANOTHER DIRECTION

■ FROZEN FOOD LOCKER operators can capitalize on the growing field of processing and merchandising, according to a recent study made by the USDA Farmer Cooperative Service.

The industry can expand by handling more custom processing. by processing for sale, and by buying and reselling products. This is important, because revenue from renting lockers is expected to decline in relative importance as more and more people acquire home freezers.

The survey was conducted by L. B. Mann, head of the Frozen Food Locker Branch of FCS, and assistants P. C. Wilkins and B. D. Miner.

They found that many plants have not developed their facilities to the fullest extent. There is still room for expansion of the custom processing business of chilling, aging, cutting, grinding, wrapping, and freezing as well as of slaughtering livestock, dressing poultry, processing fruits and vegetables, curing pork, and rendering lard. These services are provided by charging a fee of so much a head or pound to both locker renters and home freezer patrons.

Locker plants have made a substantial start toward processing locally grown products, particularly livestock and poultry, for resale to home freezer owners and institutional trades. This cuts costs by saving transportation to distant processing centers and, at the same time, increases consumption. (Eating one more pound of pork or poultry meat per person per year would use up 20 million bushels of surplus grain.)

The frozen food locker industry may develop still further by buying and reselling products. Merchandising and delivery of packer meat in wholesale cuts, commercial frozen foods, and ice cream is expanding.

Plants with a capacity of 600 to 800 lockers show the lowest discontinuance rate. Those that provide a complete processing service in rural or small towns are most successful. Plants are able to supply products at lower costs by reducing transportation and marketing expenses. A total of 5 million locker and home freezer patrons were served in 1955, an increase of 600,000 since 1950.

Locker operators can increase profits by improving services and products, operating efficiently, and adjusting to changing conditions. ☆

# C—USABLE FROM MANY SOURCES

■ WE HAVE INFORMATION on how much ascorbic acid (vitamin C) human beings need for good health, and we know the ascorbic acid content of many foods. Now USDA-sponsored experiments show how much of the ascorbic acid normal humans utilize from certain foods.

In these studies, healthy young women ate a basal diet low in ascorbic acid—plus one of the foods being tested. Enough of the test food was eaten to supply 50 milligrams of ascorbic acid. Each day, researchers analyzed samples of the women's blood and urine for ascorbic acid.

Bodily levels of ascorbic acid were compared with those found when the women ate the basal diet without the test food but with 50 mg. of ascorbic acid in crystalline form.

These women utilized the ascorbic acid in all test foods as well as that in crystalline form. Practically all the women maintained the same level of ascorbic acid in their blood on the different sources of ascorbic acid—showing that it was well absorbed from the digestive tract regardless of the food. Balances between amount of acid eaten and amount excreted in the urine also were the same—the body used each source equally well.

The studies were made for ARS Human Nutrition Research Branch by the University of Alabama, Pennsylvania State University, and Purdue University. Foods tested: *Alabama*—broccoli, cooked and raw cabbage, collards, kale, sweetpotatoes, strawberries, tangerines, turnip greens. *Pennsylvania*—asparagus, green and lima beans, brussels sprouts, orange juice, peaches, peas, tomato juice. *Purdue*—blackberries, cantaloupe, cauliflower, green pepper, potatoes, black raspberries, swiss-chard, and tomatoes. ☆

## Michigan tries bulk box

The new 20- to 25-bushel bulk boxes, used extensively in Michigan last year to handle windfall and bruised apples, were also used successfully to move many retailable apples from the orchard.

The bulk-box method was planned by agricultural engineers J. H. Levin, of ARS, and H. P. Gaston, of the Michigan Agricultural Experiment Station, to reduce cost of moving damaged fruit to the processor. Those engineers also designed a dumping device to empty the fruit without heavy bruising. Orchardists trying bulk-handling last year found they could also handle quality fruit, thanks to the new dumper.

The new box does away with much hand labor required when using the conventional field crates. Pickers empty the apples directly into the box. The box has a pallet base. That permits loading in the orchard by a tractor with lift and unloading at the plant by a fork-lift truck.

The new method saved 2½ cents a bushel on orchard labor, 3 cents on packing. 10 percent of the storage space, and a substantial amount in cost of boxes or crates. Overall, this averaged 13 cents a bushel.

## Fly killer from weed

The weed *Heliopsis helianthoides* has now yielded another insecticidal oil, heliopsin. Scientists are experimenting with this oil as a possible housefly poison. The weed grows wild, particularly in the Southwest. The oil has been obtained in pure state from the roots of the weed.

ARS entomologists first isolated scabrin from the same plant in the form of a yellow oil in 1951. This year they found heliopsin. Tests underway include everything from methods of harvesting the fibrous roots to determining the most effective uses for both oils against a large variety of insects. Selective plant breeding may someday increase the insecticide content of the species.

Heliopsis is a native plant. It is easy to grow on a large scale. Heliopsin is as toxic as the pyrethrin that we import from Africa. (The United States imports 90 percent of its pyrethrin supply from Africa.)

Heliopsis roots are fibrous the first 2 to 3 years, making mechanical harvesting difficult. In later years the root stock is thicker—similar to the wild plants now growing.

## Pear canning waste

Research—USDA and industrial—is uncovering ways to get rid of some 100,000 tons of pear canning waste produced annually by Pacific Coast pear canners. Direct feeding to livestock or ensiling are main uses.

The waste is considered comparable to molasses in feed value on the basis of soluble solid content. But its high water content poses a handicap in feeding and preservation for storage. For this reason, widespread use of pear canning waste is limited. Canners usually encourage feeders to accept the waste gratis. Researchers at the ARS Western Utilization Research Branch, Albany, Calif., and at West Coast university and industrial laboratories are working on methods to overcome this problem and to find other ways to use the waste.

A recently-devised method for feeding the waste involves mixing with hay, straw, or other low-moisture farm residues in sufficient quantity to absorb the excess juice, and ensiling in cement-lined pits. The lactic acid fermentation preserves the mixture and increases palatability.

Other possible products to make from the nutritious waste are juice for pear-canning sirup and the following feed items—feed yeast, molasses, dried pomace, and drum-dried waste.

## Statistics for scientists

The Fourth Southern Regional Graduate Summer Session in Statistics offers courses of interest to researchers. It's scheduled for June 12 through July 20 at the Virginia Polytechnic Institute, Blacksburg, Va.

D. B. LeLury, Director of Statistics of the Ontario (Canada) Research Foundation, will give a series of lectures, with original research data, on *Sampling of Biological Populations*. J. L. McHugh, Director of the Virginia Fisheries Laboratories, will conduct the laboratory sessions.

Another course of interest, *Analysis of Variance* presented from the regression point of view and with generalizations to multivariate analysis, will be given by E. J. Williams of Australian Commonwealth Scientific and Research Organization.

The VPI faculty will present courses in *Rank Order Statistics, Theory of Least Squares, Stochastic*

*Processes, Probability, Statistical Inference, Statistical Methods, Sampling,* and *Engineering Statistics.* Seminars utilizing data from recent statistical research work will be conducted four times weekly.

Information can be obtained and registration arranged through Boyd

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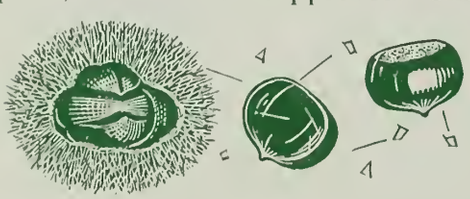
Harshberger, head of the VPI Department of Statistics. The total tuition will be $38 for the 6-week term. Each course carries 5 quarter hours of graduate credit. Other sponsoring institutions are the Southern Regional Education Board, Oklahoma A & M College, North Carolina State College and University of Florida.

## Orange-colored chestnuts

Occasional nuts with carotene-rich orange kernels have shown up on three USDA Chinese chestnut seedlings. These kernels have 5½ times the normal amount of carotenoids and 3½ times as much carotene—substance that's made into vitamin A.

Under open pollination at the Agricultural Research Center, Beltsville, Md., 2 to 6 percent of the nuts on 3 unique trees have orange kernels. ARS plant breeder J. W. McKay believes genes control this color—probably several genes. He seeks a magic combination of genes making all kernels orange. In the slow process with chestnuts, that's a distant goal.

These were first thought to be bud sports, but that was disapproved. The



coloring now seems to be influenced by specific kinds of genes in the pollen that reaches flowers at random. That points to a rare genetic influence of pollen on the cotyledons of the seed—similar to the cause of yellow cotyledons in garden peas.

Three experimental trees—identified as 8–46, 20–32, and 30–35—have some genes contributing to orange color, and only pollens from these three trees have increased the frequency of the new nut. But when these trees were crossed onto Nanking, which lacks the new character, 8–46 alone caused orange color.

Evidently the combining of two orange-kernel plasms concentrates the color factors to cause an increase in the number of orange kernels per tree. When the 20–32 pollen was put onto 8–46 flowers, it produced orange kernels in 16 percent of the nuts. And 8–46 pollen crossed onto 30–35 flowers resulted in 24 percent of the nuts having orange kernels.

## Taste teaser: blubarb jam

Blubarb jam—a blend of blueberries and rhubarb—holds promise for housewives because it's tasty and for growers because its sale could expand outlets for their crops.

This unique product was developed experimentally by researchers at the Puyallup, Wash., station of USDA's Western Utilization Research Branch, Albany, Calif. The new jam is not yet available commercially.

Blueberry jam is too bland to be really tasty and too expensive to be practical. On the other hand, rhubarb jam is too tart-tasting for eating pleasure and is quite cheap. Blended together in jam, each ingredient complements the other, resulting in a tempting wild-berry flavor.

Adding rhubarb to blueberries makes a tastier jam and also lowers


its cost substantially. Furthermore, this eliminates the need for lemon juice which is required for blueberry jam. Blubarb goes well in pie mix and pancake sirup.

## Cheaper heifer ration

Dairy heifers can be raised to first calving at much less cost by feeding large quantities of high-quality forage with plenty of legume content and much less milk and grain than customary, USDA research shows.

Heifers fed this way at Beltsville, Md., grew normally without receiving milk beyond 60 days or grain beyond 9 months. That took only 560 pounds of concentrates. Calves frequently are fed whole or skim milk up to 6 months and concentrates plus roughage until calving. That takes 2,000 to 3,500 pounds of grain.

Quality roughages that gave good growth in these tests, when fed with alfalfa, were: corn silage, timothy hay and corn silage, Ladino-bromegrass hay and corn silage, and timothy hay plus Ladino-orchardgrass hay. Alfalfa alone met the need.

Ohio Agricultural Experiment Station recently made similar findings.



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